

CLAIMS

What is claimed is:

1. A forming apparatus for forming a sheet of polymeric material, said forming apparatus comprising:

    a first mold half having a bottom wall and a first side wall defining a first interior space said first side wall having a first edge;

    a second mold half having a top wall and a second side wall defining a second interior space, said second side wall having a second edge, wherein said first and second halves selectively clamp the sheet between said first and second edges for forming the sheet therebetween, whereby the sheet is vacuum drawn into one of said first and second interior spaces;

    a cooling mechanism disposed within one of said first and second interior spaces; and

    a sensing mechanism attached to one of said first and second halves for sensing a draw depth of the sheet within one of said first and second interior spaces.

2. A forming apparatus for forming a sheet of polymeric material as set forth in claim 1, wherein the sheet includes a peripheral edge and a center portion, whereby said first and second edges selectively support the sheet with said center portion spaced from said first and second mold halves.

3. A forming apparatus for forming a sheet of polymeric material as set forth in claim 1, wherein said first edge is contoured for defining an edge form of the sheet and said second edge is correspondingly contoured for facilitating clamping of the sheet between said first and second halves.

4. A forming apparatus for forming a sheet of polymeric material as set forth in claim 1, wherein said first edge is beveled and said second edge is correspondingly beveled for facilitating clamping of the sheet between said first and second halves.

5. A forming apparatus for forming a sheet of polymeric material as set forth in claim 1, further comprising a trimming mechanism for trimming a perimeter of the sheet to a desired shape.

6. A forming apparatus for forming a sheet of polymeric material as set forth in claim 5, wherein said trimming mechanism comprises a plurality of blades disposed about a perimeter of one of said first and second halves for trimming said perimeter of the sheet upon clamping of the sheet between said first and second halves.

7. A forming apparatus for forming a sheet of polymeric material as set forth in claim 1, wherein said cooling mechanism includes at least one fan.

8. A forming apparatus for forming a sheet of polymeric material as set forth in claim 1, wherein said sensing mechanism comprises a laser fixedly attached to one of said first and second halves for generating a beam of laser light across one of said first and second interior spaces and a sensor for detecting interruption of said beam within one of said first and second interior spaces.

9. A forming apparatus for forming a sheet of polymeric material as set forth in claim 1, further comprising:

a retention mechanism operatively supported by one of said first and second halves for biasing the sheet into contact with one of said first and second edges of the other of said first and second halves.

10. A forming apparatus for forming a sheet of polymeric material as set forth in claim 9, wherein said retention mechanism comprises:

    a retention pin slidably disposed within a cavity of one of said first and second halves, and including a pin portion slideable through an opening of one of said first and second edges; and

    a spring operatively disposed within said cavity for biasing said retention pin whereby said pin portion extends outward through said opening.

11. A forming apparatus for forming a sheet of polymeric material, said forming apparatus comprising:

    a first half defining a first interior cavity and a first peripheral outer edge;

    a second half defining a second interior cavity having a second peripheral outer edge;

    wherein said first and second halves selectively clamp the sheet therebetween and a vacuum is generated within one of said first and second interior cavities for drawing the sheet therein; and

    a cooling mechanism operatively disposed within one of said first and second interior cavities for cooling the sheet from a first temperature upon sufficient drawing of the sheet into one of said first and second interior cavities.

12. A forming apparatus for forming a sheet of polymeric material as set forth in claim 11, wherein the sheet includes a peripheral edge and a center portion, whereby said first and second edges selectively support the sheet with said center portion spaced from said first and second mold halves.

13. A forming apparatus for forming a sheet of polymeric material as set forth in claim 11, wherein said first peripheral outer edge is contoured for defining an edge form of the sheet and said second peripheral outer edge is correspondingly contoured for facilitating clamping of the sheet between said first and second halves.

14. A forming apparatus for forming a sheet of polymeric material as set forth in claim 11, wherein said first peripheral outer edge is beveled and said second peripheral outer edge is correspondingly beveled for facilitating clamping of the sheet between said first and second halves.

15. A forming apparatus for forming a sheet of polymeric material as set forth in claim 11, wherein said cooling mechanism includes at least one fan.

16. A forming apparatus for forming a sheet of polymeric material as set forth in claim 11, further comprising:

a sensing mechanism fixedly attached to one of said first and second halves for sensing a draw depth of the sheet within one of said first and second interior cavities.

17. A forming apparatus for forming a sheet of polymeric material as set forth in claim 16, wherein said sensing mechanism comprises a laser fixedly attached to one of said first and second halves for generating a beam of laser light across one of said first and second cavities and a sensor for detecting interruption of said beam within one of said first and second interior spaces.

18. A forming apparatus for forming a sheet of polymeric material as set forth in claim 17, wherein said sensing mechanism further comprises a reflector for reflecting said beam of laser light within either of said first and second interior spaces.

19. A forming apparatus for forming a sheet of polymeric material as set forth in claim 11, further comprising:

a retention mechanism operatively supported by one of said first and second halves for biasing the sheet into contact with one of said first and second peripheral outer edges of said first and second halves.

20. A forming apparatus for forming a sheet of polymeric material as set forth in claim 19, wherein said retention mechanism comprises:

a retention pin slidably disposed within a cavity of one of said first and second halves, and including a pin portion slidable through an opening of one of said first and second peripheral outer edges; and

a spring operatively disposed within said cavity for biasing said retention pin whereby said pin portion extends outward through said opening.

21. A forming apparatus for forming a sheet of polymeric material as set forth in claim 11, further comprising a trimming mechanism for trimming a perimeter of said sheet to a desired shape.

22. A forming apparatus for forming a sheet of polymeric material as set forth in claim 21, wherein said trimming mechanism comprises a blade disposed about a perimeter of one of said first and second halves for trimming said perimeter of the sheet upon engagement with the other of said first and second halves.

23. A forming apparatus for forming a sheet of polymeric material as set forth in claim 21, wherein said trimming mechanism comprises a series of blades disposed about a perimeter of one of said first and second halves, wherein each of said blades includes an angled cutting edge thereby providing a series of progressive trimming sections along said perimeter.

24. A forming apparatus for forming a sheet of polymeric material as set forth in claim 21, wherein said trimming mechanism comprises a laser trimming apparatus orbital about said perimeter.

25. A forming apparatus for forming a sheet of polymeric material as set forth in claim 21, wherein said trimming mechanism comprises a water-jet trimming apparatus orbital about said perimeter.

26. A method for forming a sheet of polymeric material, comprising the steps of:

heating the sheet to a first temperature;

retaining the sheet between first and second mold halves of a forming mold with the sheet supported along a peripheral edge;

generating a vacuum on one side of the sheet thereby drawing the sheet into an interior space of one of said first and second mold halves while a center portion of the sheet remains supported in space relationship to said first and second mold halves; and

cooling the sheet from said first temperature to a second temperature upon achieving a specified draw depth of the sheet within one of said first and second mold halves.

27. A method for forming a sheet of polymeric material as set forth in claim 26, further comprising the step of detecting a draw depth of the sheet within one of said first and second mold halves for initiating said cooling.

28. A method for forming a sheet of polymeric material as set forth in claim 27, wherein said detecting of said draw depth is achieved using a laser and sensor.

29. A method for forming a sheet of polymeric material as set forth in claim 26, further comprising the step of trimming a perimeter of the sheet to a desired shape.

30. A method for forming a sheet of polymeric material as set forth in claim 29, wherein said trimming of said perimeter is achieved using a blade disposed about a perimeter of one of said first and second mold halves for trimming said perimeter of the sheet upon retention of the sheet between said first and second halves.

31. A forming apparatus for forming a sheet of polymeric material as set forth in claim 29, wherein said trimming of said perimeter is achieved using a series of blades disposed about a perimeter of one of said first and second halves, wherein each of said blades includes an angled cutting edge thereby providing a series of progressive trimming sections along said perimeter.

32. A method for forming a sheet of polymeric material as set forth in claim 26, further comprising the steps of:

    relieving said vacuum from said one side of the sheet;

    withdrawing one of said first and second mold halves from the other of said first and second mold halves; and

    removing said sheet from said forming mold.

33. A method for forming a sheet of polymeric material as set forth in claim 26, wherein said first temperature is greater than or equal to a glass transition temperature of the sheet and less than a melting temperature of the sheet.

34. A method for forming a sheet of polymeric material as set forth in claim 26, wherein said second temperature is less than a glass transition temperature of the sheet.

35. A method for forming a sheet of polymeric material as set forth in claim 26, wherein said heating of the sheet occurs in stages.

36. A forming apparatus for forming a sheet of polymeric material, said forming apparatus comprising:

a first mold half defining a first interior space having a first edge;

a second mold half defining a second interior space having a second edge;

wherein said first and second mold halves come together to selectively clamp the sheet therebetween, whereby the sheet is solely supported by one of the first and second edges throughout a forming process.

37. A forming apparatus for forming a sheet of polymeric material, as set forth in claim 36, further comprising a cooling mechanism disposed within one of said first and second interior spaces.

38. A forming apparatus for forming a sheet of polymeric material, as set forth in claim 36, further comprising a sensing mechanism attached to one of said first and second halves for sensing a draw depth of the sheet during said forming process.